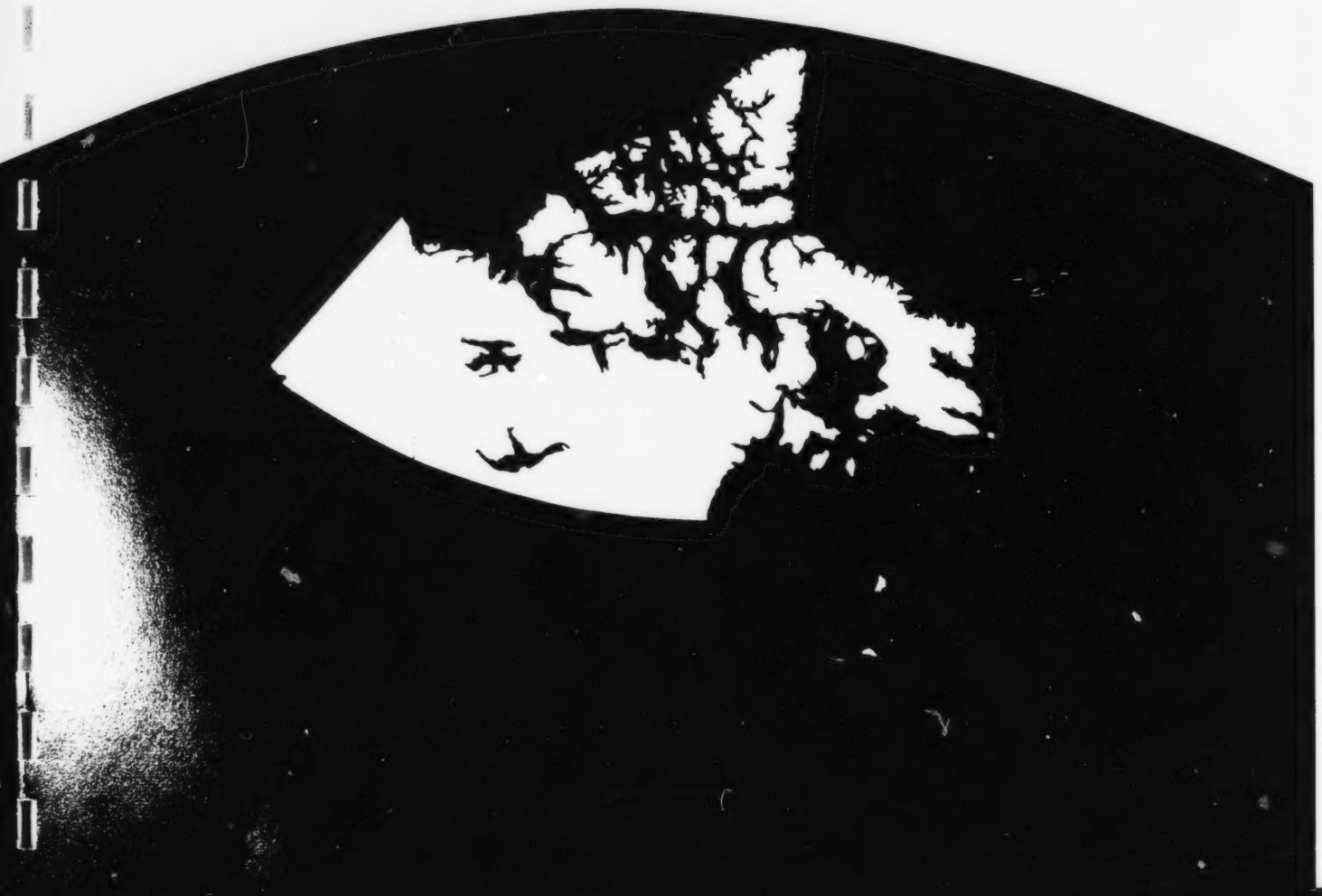
Indian and Northern Affairs Canada

Affaires indiennes et du Nord Canada

Northern Affairs Program



THE DIAND SOCIO-ECONOMIC IMPACT MONITORING PROGRAM: ESTABLISHMENT OF EXISTING SOCIOECONOMIC CONDITIONS

Report No. 5-84

Prepared for:

DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT
Les Terrasses de la Chaudiére
Ottawa. KlA 0H4

M.B. Green
Department of Geography
University of London
London, Canada

R.M. Bone
Department of Geography
University of Saskatchewan
Saskatoon, S7N 0W0

March, 1984

PREFACE

The Norman Wells Oilfield Expansion and Pipeline Project is the first major hydrocarbon development in the North. As such, it offers unique opportunities to observe at first hand the effects of a development project on the environment, the economy and the social fabric of the region. There have been a number of extensive public review processes dealing with major development project proposals, e.g., the Berger Inquiry, and the Environmental Assessment Review Panel (EARP) on the Norman Wells Project itself, which have debated extensively the possible effects of such projects. There have, however, been relatively few opportunities to observe the effects at the time the project is in the construction phase, the time of most likely disruption in a region.

Accordingly, the Department of Indian Affairs and Northern Development mounted a monitoring program with the objective of identifying the impacts, negative and positive, of the Norman Wells Project as development proceeded. The four Mackenzie Valley communities closest to the project are Norman Wells itself, Fort Norman, Fort Simpson and Wrigley. Against the background of a database survey carried out in 1982 intended to provide the picture "before" the start of major construction, the DIAND Norman Wells Socio-Economic Impact Monitoring Program has developed a comprehensive battery of data on certain selected economic and social factors through the conduct of annual field surveys.

This program is, we believe, the first impact monitoring program of its kind, covering as it does the community situations "before", "during" and "after" project construction. The program is under the direction of Professor R.M. Bone of the University of Saskatchewan. Results are being presented in a series of technical reports pertaining to each year for which the survey has been carried out. The present report is designed to provide a comprehensive picture of the program findings from 1982 through 1984. A full list of published reports is presented in the Bibliography.

John Hucker
Director General
Northern Policy and
Coordination

TABLE OF CONTENTS

1. INTRODUCTION 1

2. HISTORICAL DEVELOPMENT OF NORMAN WELLS AND PIPELINE 1

3. FEDERAL RESPONSIBILITY AND INVOLVEMENT 3

4. SOCIO-ECONOMIC INDICES 4

5. APPLICATION OF METHODOLOGY TO SURVEY DATA 8

6. CONCLUSIONS 18

7. REFERENCES 20

8. DIAND MONITORING REPORTS 48

LIST OF TABLES

Table 1	List of Variables in Analyses	21
Table 2	Regression Equations for Missing Case Prediction. .	22
Table 3	Explanation of Variance by Seven Principal Components - Norman Wells, Fort Norman, Wrigley and Fort Simpson	23
Table 4	Varimax Rotated Principal Components Matrix for Norman Wells, Fort Norman, Wrigley and Nort Simpson	24
Table 5	Variables Associated with Principal Components. . .	25
Table 6	Overall and Component Indices - All Respondents . .	26
Table 7	Explanation of Variance by Seven Principal Components - Forman Wells, Fort Norman, Wrigley and Fort Simpson Treaty Indian, Non-status Indians, Metis and Inuit Respondents	27
Table 8	Varimax Rotated Principal Components Matrix for Norman Wells, Fort Norman, Wrigley, and Fort Simpson Treaty Indian, Non-status Indians, Metis and Inuit Respondents	28
Table 9	Variables Associated with Principal Components Native Respondents.	29
Table 10	Directly Comparable Components	30
Table 11	Overall and Component Indices - Non-Native Respondents	31
Table 12	Explanation of Variance by Seven Principal Components Norman Wells, Fort Norman, Wrigley and Fort Simpons - Non-Native Respondents	32
Table 13	Varimax Rotated Principal Components Matrix for Norman Wells, Fort Norman, Wrigley, and Fort Simpson - Non-Native Respondents.	33
Table 14	Variables Associated with Principal Components Non-Native Respondents	34

Table 15 Overall and Component Indices - Non-Native Respondents 35

Table 16 Explanation of Variance by Seven Principal Compondents for Norman Wells 36

Table 17 Varimax Rotated Principal Components Matrix for Norman Wells 37

Table 18 Variables Associated with Principal Components Norman Wells 38

Table 19 Explanation of Variance by Seven Principal Components for Fort Simpson 39

Table 20 Varimax Rotated Principal Components Matrix for Fort Simpson 40

Table 21 Variables Associated with Principal Components Fort Simpson 41

Table 22 Explanation of Variance by Seven Principal Components for Fort Norman 42

Table 23 Varimax Rotated Principal Components Matrix for Fort Norman 43

Table 24 Variables Associated with Principal Components Fort Norman 44

Table 25 Explanation of Variance by Seven Principal Components for Wrigley 45

Table 26 Varimax Rotated Principal Components Matrix for Fort Norman 46

Rable 27 Variables Associated with Principal Components Wrigley 47

INTRODUCTION

The development of the Norman Wells oil field by Esso Resources Ltd. and the construction of a pipeline by Interprovincial Pipeline (IPL) to Zama, Alberta has lead to a concern with the socioeconomic impacts that may occur in communities along the pipeline route. This paper proposes and exemplifies a principal components approach to the creation of socioeconomic indices to help monitor such changes.

HISTORICAL DEVELOPMENT OF NORMAN WELLS AND PIPELINE

Norman Wells, a small community on the Mackenzie River owes its origin to the petroleum industry. While the drilling for oil by Imperial Oil took place in 1920, a firm market for this product did not appear until 1932. At that time the demand for diesel fuel came from the pitchblende mine at Port Radium. Three years later, the opening of the Con and Negus goldmines at Yellowknife added to the need for petroleum products from Norman Wells.

During World War II, the Norman Wells oil field took on strategic importance in the Pacific war zone. To ensure its supply of petroleum to its military bases in Alaska, the United States Army devised a plan to supply oil by an overland route from Norman Wells to Whitehorse and then to Alaska. This plan, known as the Canol Project, would increase production at Norman Wells and ship the crude oil by pipeline to Whitehorse. By 1944, the Canol pipeline had been built but a year later, the threat of a Japanese attack on Alaska had disappeared. Without the military need for Norman Wells oil, the Canol pipeline could not be kept open and, in 1945, this pipeline was closed.

Following the Second World War, Canada ceased to ignore its northern frontier. Government investment in infrastructure and the provision of

services led the way. Many of these developments called for petroleum products and, as a result, output at Norman Wells began to climb. The growth of villages along the Mackenzie water system provided it with a market area stretching from Hay River in the south to Tuktoyaktuk in the north. By the 1970s, its annual production was around 150,000 m^3 (Figure 1).

With the rising price of oil in the 1970s, Imperial Oil decided to expand its operation at Norman Wells and to ship new production to southern markets by a pipeline. In 1980, Esso Resources Ltd. (formerly Imperial Oil) submitted its Norman Wells Oilfield Expansion and Pipeline project to the federal government. This plan called for an increase in annual production from 180,000 m^3 per year to nearly 1-1/2 million m^3. To ship this new production to southern markets, Esso Resources planned to build a 324 mm pipeline from Norman Wells to northern Alberta where it would link up with the national pipeline system (Figure 2).

The federal government reviewed this proposal and, in 1981, gave the development plan its approval. In doing so, the Report of the Federal Environmental Assessment and Review Panel (1981, p. 73) recognized that this project would provide " ... a needed economic stimulus" to the Mackenzie Valley. Its recommendations were intended to insure that economic benefits for local employment and business opportunities are realized. The FEARO Panel felt that the social pressure on the people of the Mackenzie Valley can be made "within acceptable limits" and the Panel recommendations are aimed at minimizing social disruptions (FEARO, 1981; p. 73). These recommendations included concern about (1) inflationary effects of the project upon the cost of living, (2) wage differentials between project workers and workers in other sectors of the northern economy, (3) pressure on the local housing stock, public services

and recreation facilities, and (4) trappers opting for wage employment during the construction period and then having difficulties returning to the trapping economy.

FEDERAL RESPONSIBILITY AND INVOLVEMENT

The federal government became involved in the Norman Wells Project through the Department of Indian Affairs and Northern Development (DIAND). DIAND's "northern affairs program covers management of all natural resources rorth of the 60th parallel except game, the protection of the northern e environment, government activities in economic development and support of the territorial governments in providing social and other local services" (Statistics Canada, 1981, p. 901). The government also became involved through Environment Canada (the Federal Environmental Assessment and Review Office) and the National Energy Board.

The Federal Environmental Assessment and Review Office (FEARO) held public meetings on issues relating to the rationale for the project, the potential impact on the physical environment and the human environment, government preparedness and project monitoring (FEARO, 1981, p. 3). FEARO was requested by DIAND to extend its assessment to include economic and social issues. Its review of the project led to the conclusion "that before the Norman Wells Oilfield Expansion and Pipeline Project can be built within acceptable limits of environmental and socioeconomic impact, important deficiencies in the Proponents' planning and in the preparedness of government need to be rectified" (FEARO, 1981, p.3).

The public meetings lead to concerns regarding the overall socioeconomic impact that the Project would have on local communities. To address these

concerns and the deficiencies noted by the FEARO, socioeconomic surveillance and monitoring programs were intiated by DIAND, Esso Resources, and Interprovincial Pipeline (IPL). The difference between surveillance and monitoring is in the time frame of concern. Surveillance is the appraisal of day-to-day activities, while monitoring is concerned with long term trends. Esso and IPL are responsible for the monitoring of the local impacts of their activities. It then became DIAND's responsibility under its mandate to undertake socioeconomic monitoring of the overall impact. To this end, four communities, Norman Wells, Fort Simpson, Fort Norman, and Wrigley were determined to be the most likely effected.

SOCIOECONOMIC INDICES

To meet the commitment made by the Department of Indian Affairs and Northern Development (DIAND) for monitoring the socioeconomic impacts of the Norman Wells Project, a monitoring program was proposed. DIAND expertise was not sufficient to develop and implement such a monitoring program. To obtain such expertise the northern research team at the University of Saskatchewan was contracted to develop and implement a monitoring program.

As a first step in the development of such a program, a series of surveys of the four communities of Norman Wells, Fort Simpson, Fort Norman, and Wrigley, N.W.T. was proposed. In 1982, data were collected to establish the preconstruction sociodemographic situation in the four communities. Data were collected via two comprehensive surveys. The first survy, of businesses and public services, recorded various economic activities of the firms as well as

employee registry information. The second survey, of households,[1] focused on employment, residency, and other socioeconomic indicators important to Project impact assessment and monitoring.

The large amount of data collected indicated a need to attempt to develop methods of reducing the data to more concise and manageable proportions. One such approach might be the development of summary indices of socioeconomic conditions. Previous work on the development of indices of social well-being (Smith, 1973, 1977; Wilson, 1969) indicates that the use of principal components might be a profitable approach. This paper uses principal components on the household data set to establish socioeconomic indices for the four communities.

The variables utilized in this analysis may be found in Table 1. This list is a subset of the variables available from the surveys. Much of the available data is of a nominal or ordinal level and hence are not valid for use in this suggested approach. The existence of extensive data unsuitable for analysis here indicates that the development of socioeconomic indices can only be a portion of a monitoring program.

The data can be viewed as being organized as depicted in Figure 3. The basic datum is the value of a household j in a community k on a variable i. The datum can thus be represented as

$$z_{ijk}$$

---

[1] Throughout the field survey period, a consistent definition of household was applied. Two criteria defined a household for our purposes: (1) a household is any group of persons sharing common living accommodations (the same house or apartment), AND (2) at least one member of the household has been a local resident for more than the last twelve consecutive months (since August 1981).

where Z is the standardized score of variable i

j is the household

k is the community in which household j is found.

The list of variables in Table 1 reveal that some of the variables are largely redundant in that they measure the same household characteristic. For example, household income in 1982, and male head of household income in 1982, have a correlation coefficient of .64. In order to condense the data and remove redundancy principal components is applied to the data for the communities of Norman Wells, Fort Simpson, Fort Norman and Wrigley taken collectively. Principal components should create a number of components representing the underlying dimensions of the variance in the data. Since principal components analysis is widely known and used no discussion of its theoretical foundations is presented. The reader is directed to Rummel (1970) for such a discussion.

The component loadings can be used to create factor scores which can be thought of as indices or measures of the socioeconomic condition of a particular data case, in this instance, an individual household. The factor scores can be generated by the use of component loadings and the standardized scores of the original variables Z_{ijk}. The formula for factor scores is

$$I_{jkp} = \sum_{i=1}^{n} L_{ip} Z_{ijk}$$

where I_{jkp} is the magnitude of the indicator of household j in community k for a component p

L_{ip} is the loading of variable i for component p

Z_{ijk} is the standardized score of variable i for household j in community k.

This indicator or index provides a measure of where a particular household j falls in relation to the mean household on a component. A value of -1.34 indicates for instance, that the household is 1.34 standard deviations away from the mean in a negative direction.

These indicators while useful, do not provide a measure of the general condition of the community compared to other communities. To obtain such a measure the household indicator values may be aggregated to produce community indices by the use of the following formula:

$$C_{kp} = \sum_{j=1}^{m} I_{jkp}$$

where C_{kp} is the magnitude of the indicator of community k for component p.

The C_{kp}'s allow for comparison across k communities for a particular component p. For example, if Norman Wells has a C_{kp} of 34.8 on a component measuring male income, while Fort Norman has a C_{kp} of -38.9, it is clear that Norman Wells is far better off with regard to male income (Table 6). The 34.8 is the sum of the standard deviation of the households in Norman Wells with regard to the overall mean of the four communities. The 34.8 indicates that the majority of the households enjoy male income substantially higher than the mean.

The community indices do not however, provide an overall measure of socioeconomic condition allowing comparison across communities. To obtain such a measure the community indices may be aggregated to produce an overall index O_k. O_k is derived by:

$$O_k = \sum_{p=1}^{q} C_{kp} \quad .$$

where O_k is the overall indicator for community k.

This index allows for comparison of general conditions across communities.

It should be noted that the formulation I_{jkp}, C_{kp} and O_k assume an equal weight for each term in the summation. This need not be assumed if weights are inserted into the summation. For instance, the individual household indicator could be modified as follows:

$$I_{jkp} = \sum_{i=1}^{n} W_{ip} L_{ip} Z_{ijk}$$

where W_{ip} is the weight assigned to the loading of variable i for component p.

It is also possible to create factor scores by only utilizing a selected set of the variables for use in the summations. This is equivalent to giving greater weights to those variables deemed most important.

APPLICATION OF METHODOLOGY TO SURVEY DATA

The data to be utilized in the analyses presented in this report had a number of missing values. These missing values being the result of the respondent's refusal to answer a particular question. Such a refusal being due to lack of knowledge as to the answer or a desire to retain his privacy. In order to maximize the number of useful cases multiple regression is utilized to generate predictions for some of the missing cases.

Three variables in particular had a large number of missing cases, these being: male income for 1982 (MALINC82), female income for 1982 (FEMINC82), and part time income for 1982 (PART82). As full as possible representation of these variables in the data set is particularly important since income is a prime determinant of standard of living. The regression equations may be found in Table 2.

As one would expect income in the same year is an excellent predictor for income in 1982. When possible 1982 income levels were utilized. If 1982 responses were also missing 1981 income levels are utilized. Given the dual nature of the northern economy, regression equations were estimated seperately for native and non native groups. Native is defined as a respondent who is a treaty Indian, nonstatus Indian, Metis, or Inuit. Non native is a respondent who is none of the above. The bulk of non natives are of course white. The equations' coefficients are all significant at .001 and all exhibit quite respectable correlation coefficients.

Principal components was applied to the regression adjusted survey data obtained for Norman Wells, Fort Simpson, Fort Norman and Wrigley settlements. Seven components were found to explain greater than 5% of the variance (Table 3), capturing 75% of the variance in 18 variables. The matrix of the varimax rotated loadings may be found in Table 4. In general, the variables can be unambiguously assigned to a single component. Three variables are exceptions to this, the number of household members unemployed, the number of preschoolers in a household, and the per cent country food makes up the household's diet. The intermediate loadings of these variables means they could be assigned to a number of components. The communalities indicate the per cent of the variance of the original variable captured by the components. The communalities are quite high for all the variables, except per cent country food which is not explained well by the components. These high communalities indicate all the variables except one are well represented in the solution.

The seven components may be named by reference to the variables that load highly upon them. The seven components have been named; family structure, male income, female income, part time work, commuting, permanency and

full time work (Table 5). The membership of the components fulfill one's intuitive expectations as to which variables should be highly intercorrelated.

The principal components loadings matrix and the standardized scores of the original data were used to generate the household indicators I_{jkp}. These I_{jkp}'s were then aggregated to produce the community indices C_{kp} which may be found in Table 6. The family structure, male income, female income, part time work, and commuting indices have their signs reversed so that positive values indicate the conditions generally associated with higher levels of development.

Table 6 indicates that of the four communities, Norman Wells generally has the highest community indices as well as the highest overall index value. This is to be expected since Norman Wells has the highest proportion of non native population. Fort Norman has the lowest community indices values as well as the lowest overall index value. Fort Simpson, a mixed community, and Wrigley, a native community, occupy the middle values. The community and overall indices thus generally coincide with expectations given the population distribution of the communities.

The socioeconomic indices produced for the aggregate survey population provide measures of overall community condition. Northern communities however, are not ethnically homogeneous. For the purpose of this report a dichotomous division into native and non native groups is made. Treaty Indians, nonstatus Indians, Metis and the Inuit are classified as native, while any other ethnicity is deemed non native. The non native category is of course numerically dominated by the white population. The division is based on the descent of the respondent (RESDES).

In some cases it may be difficult to assess the descent of the head of household. With ties at any position (ie. two single persons in the same

household, both with full-time jobs, one thirty years old, the other twenty years old) the decision falls to the last category, age. In this case the older resident would be classified as the household head.

DESCENT:

Male Head	Female Head	Children
Treaty Indian	(regardless)	Treaty Indian
Non Status Indian	(regardless)	Non Status Indian
Metis	(regardless)	Metis
Inuit	(regardless)	Inuit
Other	Treaty Indian	Non Status Indian
Other	Non Status Indian	Non Status Indian
Other	Metis	Metis
Other	Inuit	Inuit
Other	Other	Other

* In those instances where there is only one head of household (either male or female), the descent of the children is taken to be the same as the parent.

Once the survey data is divided into native and non native groups, the creation of socioeconomic indices for each group becomes possible. The results of the principal components analysis of the native group may be found in Tables 7 and 8. Table 7 shows that approximately 82 per cent of the variance is captured. The varimax rotated principal components matrix is found in Table 8.

One could anticipate that the relationships between the variables available from the survey would be different for the two ethnic groups. This is indeed the case. The loadings of the variables on the various factors for the native group are somewhat different than those associated with the aggregate

population. Table 9 presents the seven components and the variables associated with them. Some of the components are the same as in the aggregated population's components, such as family structure, part time work, permanency, and commuter (Table 10). The remaining three components are quite similar in makeup although not directly comparable to the aggregate population's components.

Since the components are not entirely identical the indices derived from them measure socioeconomic conditions somewhat differently. While this prevents direct comparison between all respondents and native respondents, it does imply that the possibility of temporal replication is improved. The relationships between the variables in the more homogeneous native group is unlikely to change significantly over the time frame of the monitoring project. Therefore, the composition of the components should remain constant, with only the indices' values changing. Comparison across time is therefore possible.

The socioeconomic indices derived from the components are found in Table 11. The community of Norman Wells is taken as the base community for comparison. Negative signed indices were converted to positive sign for Norman Wells with corresponding changes in sign in the components for the other communities.

Norman Wells again has the highest indices values. Fort Norman has the lowest values, with Wrigley and Fort Simpson occupying the middle ranges. The communities occupy the same rankings as in the aggregate population's indices.

The same procedure was followed in the analysis of the non native respondents. Tables 12 and 13 provide the results of the analysis. The variance captured is somewhat lower, approximately 72 per cent (Table 12). The

varimax rotated principal components matrix is found in Table 13. The communalities are generally high and acceptable.

As in the case of the analysis of the native respondents, the loadings are distributed somewhat differently than in the analysis of all of the respondents. The variables and their associated components are found in Table 14. The loadings of the variables are sufficiently different to force the creation of a new component, age, to take the place of full time work. As Table 10 shows only the components of part time work and commuter are directly comparable across all three analyses.

The socioeconomic indices derived for the non native respondents are found in Table 15. The community of Wrigley is not included because no non native cases were recorded. Norman Wells is again taken as the base community. The community index shows an interesting reversal of the rankings of Fort Norman and Fort Simpson. This reversal is largely due to the large differences in the index values of family structure, male income, and commuter. This is a case where a weighting of the components could easily produce a reversal of the community rankings.

The same type of principal components analysis can be applied to the responses from the individual communities. The community analyses are not divided into different ethnic groups because this would create ethnic subsets of insufficient size for analysis.

The application of principal components creates individual household indices. Each household can be identified by the number of standard deviations to which it is above or below the mean for the subset being analysed. Such household indices allow an examination of the inequality or dispersion in a factor for a data subset. The following community analyses are therefore

presented to establish the base for such an examination of inequality of distribution among the components.

The varimax rotated matrix for Norman Wells is found in Table 17. The components capture 82 per cent of the variance (Table 16). As in the case of the ethnic division of the survey data a sacrifice of direct comparability of components across data subsets is made in favor of temporal stability.

Table 18 shows the variables associated with each of the seven components of; family structure, female income, part time work, age, permanency, full time income, and country food. Some of the components such as familiy structure are quite similar however in structure to the same component derived for other subsets of data.

Tables 17, 20 and 21 show the results for an analysis of the Fort Simpson subset of data. 90 per cent of the variance is captured by the seven components of family structure, full time work, part time work, female income, age, country food, and commuter (Table 21). The loadings matrix can be found in (Table 20). The components of full time work, commuter, part time work, and commuter do allow some comparison with other subsets of data (Table 10).

Fort Norman's subset is analysed and presented in Tables 22, 23, and 24. Table 22 shows that the components account for 90 per cent of the variance in the original survey dates. The communalities listed in Table 23 require some comment. Communalities greater than one indicate problems with the level of missing cases. These larger than unity communalities indicate that the loadings are somewhat greater than their true value. The index values generated will also be deflated. For a complete discussion of the problem see Rummel (1970, pp. 258-261, 441). The household indices for Fort Norman should be viewed with caution.

The variables associated with the seven components can be found in Table 24. Family structure, part time work, full time work and commuter are directly comparable with a number of other subsets of data (Table 10).

The analyses for the community of Wrigley is presented for the sake of completeness only. The survey generated only twenty-one cases for the community. This low number of cases makes any analysis of Wrigley suspect. The results may be found in Tables 25, 26, and 27.

The cumulative percentage explained by the seven principal components varies for the four communities from a high of 90.5% for Wrigley to a low of 78.8% for Fort Simpson. The differences in the cumulative explained variance can be attributed to differing degrees of homogeneity of the population with regards to ethnicity. The less ethnically homogeneous a community is, the greater the likelihood that the structural relationship between the variables for the population will vary. In other words, the native population may well exhibit a different relationship between family structure and employment than do non natives. This mixing of relationships makes recovery of a satisfactory principal components solution more difficult. This difficulty again illustrates the desirability of pursuing the analysis separately for natives and non natives.

The household indices, the I_{jkp}'s, may be either positive or negative depending on the household's relative position with regard to the mean. Given that these indices concisely describe a household's condition on a particular component, it then becomes reasonable to discuss the equality present within a community for a particular index such as male income.

A widely used graphical method of displaying equality is the Lorenz curve. The cumulative percentage of ranked data is plotted against the

cumulative percentage of the population having that value or less of this variable of interest. A line drawn at a 45° angle denotes the line of equality, where every member of the population exhibits the same value on the variable. The Y axis is the cumulative percentage the household index values make up of the total or the community index on that component.

Generally, the variables displayed by Lorenz curves do not exhibit negative values, and hence the curve is below the equality line. In this case however, since the component scores are standard deviations away from the mean, both negative and positive values exist. If negative and positvie values are graphed, the Lorenz curve will be above the equality line for the negative values and below the line for positive values. The degree of departure of the Lorenz curve from the equality line still represents the level of inequality present.

The Lorenz curves when drawn in this way have the advantage of showing the distribution of the indices values of both the households above as well as below the mean. It is thus possible to detect where the greatest inequality lies. The area under both the upper and lower portions of the curve represent the total level of inequality present.

The areas under the curves are approximated by finding the area of successive rectangles that approximate the areas between the equality line and the Lorenz curve.

$$\text{AREA} = \sum_{i=1}^{n} (l_i - e_i)(X_i) \quad \text{for } l > e$$

$$\text{AREA} = \sum_{i=1}^{n} (e_i - l_i)(X_i) \quad \text{for } e > l$$

where l_i is the value of cumulative probability at point i

e_i is the value of i/n where n = total number of points

X is the difference between point i and i-1

Figures 1 to Figure 7 show the modified Lorenz curves and their respective areas for the entire survey population. All the figures show that substantial variation can be found in the household indices for the seven components. Generally speaking the dispersion or inequality is greater for those households below the means of the components. This is particularly true for the family structure, male income, part time work and commuter components. The graph for family structure for instance shows that for those households smaller than average, there is a great deal more variation in family structure than for those families greater than the mean size.

A similar interpretation can be given for the graph of male income. There is a greater difference betwen male incomes below the mean than those male incomes above the mean. These graphs therefore provide an easily understood visual impression of the inequality among households for each component.

The Lorenz curves for the native respondents are depicted in Figures 8 to Figure 14. The components of family structure, female income, part time work, and commuter show the greatest inequalities. Female income for instance, shows a greater inequality among earners below the mean. Differences in income levels below the mean must therefore be relatively concentrated at a low value. This is indeed the case with the majority of female income earners in 1983 having a value of 0.

The non native graphs are Figures 15 to Figure 21. Female income again shows considerable inequality for those below the mean. The male income, part time work, commuter, and age components also show considerable inequality.

The graphs for the four communities can be found in Figures 22 to Figure 49. Generally the greatest inequality is found for those households below the mean. Such a result is probably an outcome of many households being at a level of socioeconomic condition substantially below that found at the average, so that even a modest difference in standard of living generates a considerable variation below a mean that has a low value.

The value of the graphs and their areas is somewhat limited at this point. Their greatest value will be in comparisons across time. Flattening or an accentuation of the peaks of the Lorenz curves will give an indication of how the conditions of the households are changing. A flattening of the curve will indicate a greater equality among households, while an accentuation of the peaks of the curves will indicate an increasing level of inequality of socioeconomic condition. If the goal is improvement in the general welfare of the four communities, a reduction of socioeconomic inequality is consistent with that goal.

CONCLUSIONS

This paper has presented the use of principal components analysis as a way to create a set of socioeconomic indices using the ratio level data available from household surveys. The paper shows that such indices can be created but are only as good as the data used to create them. At present, the indices measure primarily only the economic and demographic characteristics of the households. To expand the usefulness of the indices the collection of secondary data from government sources such as electrical power consumption, trapping income, and welfare payments is necessary. With the inclusion of such data the indices could present a more balanced view of conditions in the communities.

Obviously, the most interesting portion of the analysis and the test of the usefulness of this suggested methodology will come with the examination of changes over time. The indices and Lorenz curves should prove most useful in summarizing the changes that take place and may allow for mitigation of undesirable outcomes as they are detected.

To this end of temporal comparability, the survey data was subdivided to ensure the likelihood of a relatively constant structure between the variables. To accomplish this it was unfortunately necessary to sacrifice comparability of socioeconomic components across data subsets. This is not problematic since the primary goal is the monitoring of change through time.

The analyses presented here do however provide a baseline description of conditions for the entire survey, native and non native respondents, as well as conditions in the four communities.

LITERATURE CITED

Federal Environmental Assessment Review Office (FEARO), 1981, Norman Wells Oilfield Development and Pipeline Project, Ottawa, Minister of Supply and Services.

Rummel, R. J., Applied Factor Analysis, 1970, Evanston, Northwestern University Press.

Smith, D. M., The Geography of Social Well-Being in the United States, 1973, New York, McGraw Hill.

Smith, D. M., Human Geography: A Welfare Approach, 1977, London, Butter and Tanner.

Statistics Canada, Canada Year Book 1980-1981, 1981, Ottawa, Minister of Supply and Services.

Wilson, J. O., Quality of Life in the United States: An Excursion into the New Frontier of Socioeconomic Indicators, 1969, Kansas City, Midwest Research Institute.

TABLE 1

List of Variables in Analyses

1.	Age of Respondent	(RESAGE)
2.	Number of Years as Local Resident	(RESYR)
3.	Number of Years at Last Residence	(LASTYR)
4.	Number of Household Members	(HSEMEM)
5.	Number of Males in Household	(MALE)
6.	Number of Females in Household	(FEMALE)
7.	Number of Members of Household Employed Full Time	(FULL)
8.	Number of Members of Household Employed Part Time	(PART)
9.	Number of Housewives in Household	(HSEWFE)
10.	Number of Students in Household	(STUD)
11.	Number of Preschoolers in Household	(PRESCH)
12.	Household Income in 1981	(HSEINC81)
13.	Household Income in 1982	(HSEINC82)
14.	Income of Male Head of Household 1981	(MALINC81)
15.	Income of Male Head of Household 1982	(MALINC82)
16.	Income of Female Head of Household 1981	(FEMINC81)
17.	Income of Female Head of Household 1982	(FEMINC82)
18.	Full Time Income 1981	(FULL81)
19.	Full Time Income 1982	(FULL82)
20.	Part Time Income 1981	(PART81)
21.	Part Time Income 1982	(PART82)
22.	% of Country Food in Diet	(COUNTRY)
23.	Number of Commuters in Household	(COMMUTER)
24.	Number of Retirees in Household	(RETIRE)
25.	Descent of Respondents	(RESDES)
26.	Number of Unemployed in Household	(UNEMP)

TABLE 2

Regression Equations for Missing Case Prediction*

Variable Predicted		
a) Male Income 1982	MALINC82 = 11.95 + .806 FULL82 - 8.0 RETIRE - 7.64 FULL	r^2 = .81
b) Male Income 1982	MALINC82 = 12.11 + .62 FULL81 - 9.14 RETIRE - 2.17 FULL	r^2 = .85
c) Male Income 1982	MALINC82 = 23.32 + .71 FULL82 - 11.44 FULL - 8.83 RETIRE	r^2 = .73
d) Male Income 1982	MALINC82 = 23.44 + .57 FULL81 - 7.36 FULL - 8.9 RETIRE	r^2 = .57
a) Female Income 1982	FEMINC82 = -.77 + 1.0 FEMINC82	r^2 = .99
b) Female Income 1982	FEMINC82 = .069 + 1.25 FEMINC81	r^2 = .91
c) Female Income 1982	FEMINC82 = -.76 + 1.04 FEMINC82	r^2 = .91
d) Female Income 1982	FEMINC82 = 3.28 + .92 FEMINC81	r^2 = .59
a) Part Time Income 1982	PART82 = .19 + .67 PART82	r^2 = .87
b) Part Time Income 1982	PART82 = .73 + .61 PART81	r^2 = .89
c) Part Time Income 1982	PART82 = -.41 + 1.07 PART82	r^2 = .69
d) Part Time Income 1982	PART82 = -.26 + 1.25 PART81	r^2 = .43

a) Native Respondents, independent variables available for 1982
b) Native Respondents, independent variables available for 1981 only
c) Non Native Respondents, independent variables available for 1982
d) Non Native Respondents, independent variables available for 1981 only

* all coefficients significant at .001

TABLE 3

Explanation of Variance by Seven Principal Components
Norman Wells, Fort Norman, Wrigley and Fort Simpson

FACTOR	EIGENVALUE	PERCENTAGE OF VARIANCE	CUMULATIVE PERCENTAGE
1	4.91	27.3	27.3
2	2.52	14.0	41.3
3	1.51	8.4	49.7
4	1.39	7.7	57.4
5	1.24	6.9	64.3
6	1.02	5.7	69.9
7	.95	5.3	75.2

TABLE 4

Varimax Rotated Principal Components Matrix for
Norman Wells, Fort Norman, Wrigley, and Fort Simpson

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	COMMUNALITY
RESAGE	.10	.79	-.06	-.04	-.13	.11	.01	.67
RESYR	.12	.78	.15	.06	.13	.00	-.19	.68
LASTYR	.04	.07	.13	.00	.18	.79	-.13	.69
HSEMEM	.95	.04	.17	.15	.13	-.08	-.07	.99
MALE	.86	.07	.12	.03	.08	.07	-.03	.78
FEMALE	.78	-.02	.16	.20	.15	-.20	-.08	.75
FULL	.27	-.47	-.62	-.21	.11	.17	.08	.77
PART	.32	.14	.16	.81	-.01	.11	-.04	.82
UNEMP	.47	.36	.18	-.03	.08	-.50	-.19	.68
HSEWFE	.41	-.13	.74	.16	-.02	.08	-.01	.76
STUD	.84	.11	-.04	.16	-.10	.14	.11	.80
PRESCH	.26	-.39	.46	-.06	.41	-.21	-.18	.68
MALINC83	.02	-.71	-.16	-.10	-.37	.17	.08	.72
FEMINC83	-.16	-.27	-.84	.02	-.07	-.14	-.01	.82
PART83	.10	-.02	.01	.92	.07	-.07	-.04	.87
FULL83	-.03	-.12	-.02	-.06	.04	-.08	.93	.90
COUNTRY	.21	.32	.17	.21	.44	.15	-.23	.50
COMMUTER	.05	.07	-.06	.00	.81	.13	.11	.69

TABLE 5

Variables Associated with Principal Components

COMPONENT 1

Family Structure

a) Number of Household Members	(HSEMEM)
b) Number of Males	(MALE)
c) Number of Females	(FEMALE)
d) Number of Students	(STUD)

COMPONENT 2

Male Income

a) Age of Respondent	(RESAGE)
b) Local Resident Years	(RESYR)
c) Male Head Income 1983	(MALINC83)

COMPONENT 3

Female Income

a) Members Employed Full Time	(FULL)
b) Female Head Income 1983	(FEMINC83)
c) Members as Housewifes	(HSEWFE)
d) Members as Preschoolers	(PRESCH)

COMPONENT 4

Part Time Work

a) Members with Part Time Job	(PART)
b) Part Time Income 1983	(PART83)

COMPONENT 5

Commuter

a) Commuters in Household	(COMMUTER)

COMPONENT 6

Permanency

a) Last Residence Years	(LASTYR)
b) Member Unemployed	(UNEMP)

COMPONENT 7

Full Time Work

a) Full Time Income 1983	(FULL83)

TABLE 6

Overall and Component Indices
All Respondents

Component	Norman Wells	Fort Norman	Wrigley	Fort Simpson
Family Stucture*	28.9	-20.3	- 9.1	- 8.2
Male Income*	34.8	-38.9	-20.8	6.8
Female Income*	19.2	- 9.1	- 7.6	- 1.7
Part Time Work*	11.1	- 3.5	-10.0	2.4
Commuting*	17.3	-38.3	- 9.7	29.5
Permanency	5.0	1.0	.4	- 6.0
Full Time Work	17.4	- 7.6	.3	-13.0
Overall Index[1]	133.7	-116.7	-56.5	9.8

*Signs reversed from loadings

[1]The overall index has a lower value of 0 and an undefined upper value. The overall index values should be read in comparison with each other. If Norman Wells is taken as the upper extreme and Fort Norman as the lower, the midpoint for the index is 8.5 Therefore Fort Simpson occupies the center. In a sense it has close to the average index value.

TABLE 7

Explanation of Variance by Seven Principal Components
Norman Wells, Fort Norman, Wrigley and Fort Simpson
Treaty Indian, Nonstatus Indians, Metis and Inuit Respondents

FACTOR	EIGENVALUE	PERCENTAGE OF VARIANCE	CUMULATIVE PERCENTAGE
1	4.20	23.3	23.3
2	3.80	21.1	44.4
3	1.69	9.4	53.8
4	1.39	7.7	61.5
5	1.39	7.7	69.3
6	1.29	7.2	76.4
7	.94	5.2	81.6

TABLE 8

Varimax Rotated Principal Components Matrix for
Norman Wells, Fort Norman, Wrigley, and Fort Simpson
Treaty Indians, Nonstatus Indians, Metis, and Inuit Respondents

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	COMMUNALITY
RESAGE	.11	-.84	-.01	.02	-.14	.05	-.03	.74
RESYR	.02	-.77	-.03	.03	.11	-.04	.16	.64
LASTYR	.04	-.16	-.31	-.21	-.68	.50	-.04	.88
HSEMEM	.93	.06	-.12	.13	.23	.15	.06	.99
MALE	.90	.02	-.01	.06	-.01	.22	-.05	.86
FEMALE	.73	.09	-.18	.13	.44	-.03	.18	.81
FULL	.38	.41	.56	-.22	-.41	-.03	.30	.93
PART	.29	-.02	-.17	.84	.00	.06	-.03	.82
UNEMP	.39	-.21	-.13	-.04	.72	.15	-.15	.78
HSEWFE	.39	.25	-.74	.07	.00	-.01	.07	.77
STUD	.86	-.07	-.07	.11	-.10	-.19	-.03	.80
PRESCH	.17	.49	.01	-.12	.36	.38	.27	.64
MALINC83	.14	.71	.21	.02	-.18	-.50	.01	.84
FEMINC83	-.14	.29	.88	-.02	.07	-.05	-.05	.88
PART83	.03	-.07	.02	.90	.07	.07	.05	.82
FULL83	.27	.61	.54	-.17	-.24	-.32	.17	.95
COUNTRY	.10	-.06	-.01	.17	-.04	.78	.09	.66
COMMUTER	.01	-.06	-.02	.03	-.05	.09	.93	.87

TABLE 9

Variables Associated with Principal Components
Native Respondents

COMPONENT 1

Family Structure

a) Number of Household Members	(HSEMEM)
b) Number of Males	(MALE)
c) Number of Females	(FEMALE)
d) Number of Students	(STUD)

COMPONENT 2

Male Income

a) Age of Respondent	(RESAGE)
b) Local Resident Years	(RESYR)
c) Male Head Income 1983	(MALINC83)
d) Full Time Income 1983	(FULL83)
e) Number of Preschoolers	(PRESCH)

COMPONENT 3

Female Income

a) Number of Household Members Employed Full Time	(FULL)
b) Number of Housewives	(HSEWFE)
c) Female Head Income	(FEMINC83)

COMPONENT 4

Part Time Work

a) Members with Part Time Job	(PART)
b) Part Time Income 1983	(PART83)

COMPONENT 5

Permanency

a) Last Residence Years	(LASTYR)
b) Members Unemployed	(UNEMP)

COMPONENT 6

Country Food

a) % of Country Food in Diet	(COUNTRY)

COMPONENT 7

Commuter

a) Commuters in Household	(COMMUTER)

TABLE 10

Directly Comparable Components

1. Family Structure

a) All Respondents
b) Native Respondents
c) Wrigley
d) Fort Norman
e) Norman Wells

2. Male Income

a) None

3. Female Income

a) None

4. Part Time Work

a) All Respondents
b) Native Respondents
c) Non Native Respondents
d) Norman Wells
e) Fort Norman
f) Wrigley
g) Fort Simpson

5. Age

a) Norman Wells
b) Non Native Respondents
c) Fort Simpson
d) Wrigley

6. Permanency

a) All Respondents
b) Native Respondents

7. Full Time Work

a) Fort Norman
b) Fort Simpson
c) Norman Wells
d) All Respondents

8. Commuter

a) All Respondents
b) Native Respondents
c) Non Native Respondents
d) Fort Simpson
e) Fort Norman

9. Country Food

a) Native Respondents
b) Norman Wells
c) Fort Simpson
d) Wrigley

10. Unemployed

a) None

TABLE 11

Overall and Component Indices
Non Native Respondents

Component	Norman Wells		Fort Norman		Wrigley		Fort Simpson	
Family Stucture*	2.1	C_{11}	- 5.8	C_{21}	- 3.1	C_{31}	5.1	C_{41}
Male Income	3.7	C_{12}	-17.1	C_{22}	- 8.2	C_{32}	12.6	C_{42}
Female Income	1.5	C_{13}	- 1.4	C_{23}	- 6.5	C_{33}	7.7	C_{43}
Part Time Work*	2.2	C_{14}	- 4.1	C_{24}	- 6.9.	C_{34}	8.9	C_{44}
Permanency*	4.6	C_{15}	- 3.1	C_{25}	.4	C_{35}	- 2.1	C_{45}
Country Food	2.5	C_{16}	12.2	C_{26}	6.1	C_{36}	-24.0	C_{46}
Commuter*	1.9	C_{17}	-22.6	C_{27}	- 4.2	C_{37}	22.4	C_{47}
Overall Index	18.5	O_1	-41.9	O_2	-22.4	O_3	8.2	O_4

*Signs reversed from factor loadings

TABLE 12

Explanation of Variance by Seven Principal Components
Norman Wells, Fort Norman, Wrigley and Fort Simpson
Non Native Respondents

FACTOR	EIGENVALUE	PERCENTAGE OF VARIANCE	CUMULATIVE PERCENTAGE
1	4.24	23.6	23.6
2	2.04	11.3	34.9
3	1.88	10.4	45.3
4	1.45	8.0	53.4
5	1.22	6.8	60.1
6	1.07	5.9	66.1
7	1.02	5.7	71.7

TABLE 13

Varimax Rotated Principal Components Matrix for
Norman Wells, Fort Norman, Wrigley, and Fort Simpson
Non Native Respondents

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	COMMUNALITY
RESAGE	.02	-.12	-.14	.83	-.11	-.07	.10	.75
RESYR	-.06	.05	.17	.83	.12	.11	.01	.74
LASTYR	-.12	.03	.22	.03	-.04	.56	.12	.40
HSEMEM	.91	.27	.26	-.02	.06	.02	.01	.98
MALE	.72	.32	-.02	.04	.00	.05	-.19	.66
FEMALE	.73	.12	.40	-.07	.09	-.01	.17	.75
FULL	.61	-.46	-.30	-.08	-.07	.12	-.23	.75
PART	.27	.08	.81	.09	.03	.12	-.04	.76
UNEMP	.25	.11	-.20	.10	.73	-.01	-.14	.68
HSEWFE	.27	.85	.21	.03	-.02	.04	-.02	.85
STUD	.70	-.05	.44	.06	-.09	-.11	.23	.77
PRESCH	.27	.72	.08	-.27	.07	.05	-.03	.68
MAL1NC83	.22	.06	-.22	.05	-.78	.04	-.21	.76
FEM1NC83	.05	-.87	.05	-.09	.00	-.02	-.06	.78
PART83	.13	.09	.81	-.05	-.04	.05	-.09	.69
FULL83	-.14	-.01	.05	-.04	.00	-.82	.04	.70
COUNTRY	.07	.09	.38	.38	.17	.21	-.17	.40
COMMUTER	.04	-.04	-.13	.06	.04	.09	.89	.82

TABLE 14

Variables Associated with Principal Components
Non Native Respondents

COMPONENT 1

Family Structure

a) Number of Household Members	(HSEMEM)
b) Number of Males	(MALE)
c) Number of Females	(FEMALE)
d) Number of Students	(STUD)
e) Number of Household Members Employed Full Time	(FULL)

COMPONENT 2

Female Income

a) Number of Housewives	(HSEWFE)
b) Number of Preschoolers	(PRESCH)
c) Female Head Income 1983	(FEMINC83)

COMPONENT 3

Part Time Work

a) Members with Part Time Job	(PART)
b) Part Time Income 1983	(PART83)

COMPONENT 4

Age

a) Age of Respondent	(RESAGE)
b) Local Resident Years	(RESYR)

COMPONENT 5

Male Income

a) Number of Members Unemployed	(UNEMP)
b) Male Head Income 1983	(MALINC83)

COMPONENT 6

Permanency

a) Last Residence Years	(LASTYR)
b) Members Employed Full Time	(FULL)

COMPONENT 7

Commuter

a) Commuters in Household	(COMMUTER)

TABLE 15

Overall and Component Indices
Non Native Respondents

Component	Norman Wells	Fort Norman	Wrigley[1]	Fort Simpson
Family Stucture*	- 8.0	3.0	-	-11.4
Female Income*	8.9	- .2	-	- 8.0
Part Time Work	6.7	2.8	-	- 1.8
Age	11.8	- 4.4	-	- 7.7
Male Income	7.6	- .6	-	- 8.6
Permanency	7.2	.2	-	- 8.4
Commuter	2.0	- 8.4	-	6.9
Overall Index	52.2	- 7.6	-	-39.0

*Signs reversed from loadings
[1]insufficient cases for computation

TABLE 16

Explanation of Variance by Seven Principal Components for Norman Wells

FACTOR	EIGENVALUE	PERCENTAGE OF VARIANCE	CUMULATIVE PERCENTAGE
1	4.41	27.6	27.6
2	2.43	15.2	42.8
3	1.77	11.0	53.8
4	1.44	9.0	62.8
5	1.32	8.3	71.1
6	.98	6.1	77.2
7	.80	5.0	82.2

TABLE 17

Varimax Rotated Principal Components Matrix for Norman Wells

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	COMMUNALITY
RESAGE	.10	-.13	.00	.85	-.03	-.12	.07	.77
RESYR	-.12	.00	.03	.87	.12	.13	-.05	.80
LASTYR	.09	.05	-.07	.10	.84	.10	.12	.76
HSEMEM	.85	.33	.25	-.05	.28	.10	.03	.99
MALE	.46	.50	.15	.03	.49	.13	-.05	.75
FEMALE	.86	.06	.25	-.10	-.03	.04	.10	.82
FULL	.72	-.35	-.11	.23	-.09	.33	.11	.83
PART	.36	.12	.80	-.02	.16	-.11	.05	.83
HSEWFE	.19	.89	.19	-.07	-.01	-.01	-.08	.87
STUD	.70	.00	.29	-.07	.45	-.22	.08	.83
PRESCH	.11	.78	.07	-.20	.07	.16	-.03	.70
MALINC83	.50	.41	-.15	.30	-.42	.30	-.07	.80
FEMINC83	.33	-.77	.13	-.14	-.02	.17	-.20	.80
PART83	.08	.04	.89	.03	-.12	.18	-.09	.85
FULL83	-.10	-.04	-.09	.00	-.09	-.88	-.11	.81
COUNTRY	.14	.00	-.04	.02	.12	.11	.95	.96

TABLE 18

Variables Associated with Principal Components
Norman Wells[1]

COMPONENT 1

Family Structure

a) Number of Household Members	(HSEMEM)
b) Number of Males	(MALE)
c) Number of Females	(FEMALE)
d) Number of Household Members Employed Full Time	(FULL)
e) Number of Students	(STUD)
f) Male Head Income 1983	(MALINC83)

COMPONENT 2

Female Income

a) Number of Housewives	(HSEWFE)
b) Number of Preschoolers	(PRESCH)
c) Female Head Income 1983	(FEMINC83)

COMPONENT 3

Part Time Work

a) Members with Part Time Job	(PART)
b) Part Time Income 1983	(PART83)

COMPONENT 4

Age

a) Age of Respondent	(RESAGE)
b) Local Resident Years	(RESYR)

COMPONENT 5

Permanency

a) Last Residence Years	(LASTYR)

COMPONENT 6

Full Time Income

a) Full Time Income 1983	(FULL83)

COMPONENT 7

Country Food

a) % Country Food in Diet	(COUNTRY)

[1]Number of Commuters, (COMMUTER); and Number of Unemployed excluded from analysis because they are near constants for Norman Wells.

TABLE 19

Explanation of Variance by Seven Principal Components for Fort Simpson

FACTOR	EIGENVALUE	PERCENTAGE OF VARIANCE	CUMULATIVE PERCENTAGE
1	4.55	25.3	25.3
2	3.39	18.8	44.1
3	1.58	8.8	52.9
4	1.43	8.0	60.8
5	1.28	7.1	68.0
6	1.02	5.7	73.6
7	.93	5.2	78.8

TABLE 20

Varimax Rotated Principal Components Matrix for Fort Simpson

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	COMMUNALITY
RESAGE	.01	-.12	-.07	.03	.85	-.01	.01	.74
RESYR	.14	-.40	.08	.05	.67	.31	.01	.73
LASTYR	-.33	.13	.14	.56	.01	-.03	-.03	.46
HSEMEM	.96	.05	.12	.07	-.02	.19	.02	.98
MALE	.81	.24	.01	.03	.07	.24	.04	.79
FEMALE	.83	-.13	.18	.10	-.13	.03	.00	.76
FULL	.09	.73	-.10	-.40	-.17	.11	.07	.76
PART	.28	-.06	.81	.17	.13	.22	.00	.84
HSEWFE	.47	-.10	.15	.67	-.13	.11	.00	.72
STUD	.79	.25	.22	.03	.17	-.11	.06	.78
PRESCH	.32	-.02	-.25	.20	-.49	.51	.01	.71
MALINC83	.07	.77	-.06	.21	-.12	-.40	-.09	.84
FEMINC83	-.26	.38	.04	-.78	-.11	-.09	-.12	.86
PART83	.12	-.19	.89	.04	-.09	-.01	-.02	.86
UNEMP	.61	-.55	-.06	-.14	.03	-.13	-.13	.74
FULL83	.21	.88	-.24	-.22	-.19	-.09	-.03	.96
COUNTRY	.10	-.12	.20	.04	.12	.77	-.11	.68
COMMUTER	.04	.00	-.02	.03	.02	-.09	.98	.97

TABLE 21

Variables Associated with Principal Components
Fort Simpson

COMPONENT 1

Family Structure

a) Number of Household Members	(HSEMEM)
b) Number of Males	(MALE)
c) Number of Females	(FEMALE)
d) Number of Students	(STUD)
e) Number of Unemployed	(UNEMP)

COMPONENT 2

Full Time Income

a) Members Employed Full Time	(FULL)
b) Full Time Income 1983	(FULL83)

COMPONENT 3

Part Time Work

a) Members with Part Time Job	(PART)
b) Part Time Income 1983	(PART83)

COMPONENT 4

Female Income

a) Number of Housewives	(HSEWFE)
b) Number of Preschoolers	(PRESCH)
c) Female Head Income 1983	(FEMINC83)

COMPONENT 5

Age

a) Age of Respondent	(RESAGE)
b) Resident Years	(RESYR)
c) Number of Preschoolers	(PRESCH)

COMPONENT 6

Country Food

a) % Country Food in Diet	(COUNTRY)

COMPONENT 7

Commuter

a) Commuters in Household	(COMMUTER)

TABLE 22

Explanation of Variance by Seven Principal Components for Fort Norman

FACTOR	EIGENVALUE	PERCENTAGE OF VARIANCE	CUMULATIVE PERCENTAGE
1	5.76	32.0	32.0
2	3.81	21.2	53.2
3	2.14	11.9	65.1
4	1.76	9.8	74.8
5	1.10	6.1	80.9
6	.91	5.1	86.0
7	.73	4.1	90.0

TABLE 23

Varimax Rotated Principal Components Matrix for Fort Norman

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	COMMUNALITY
RESAGE	.68	-.01	-.32	-.28	-.24	-.32	-.14	.81
RESYR	.87	-.10	-.18	-.15	-.14	.11	-.05	.85
LASTYR	.89	.44	.24	.03	.13	-.10	.07	1.07
HSEMEM	.12	.88	.05	.20	.20	.35	.05	.99
MALE	.14	.85	.14	.11	.20	.18	-.06	.85
FEMALE	.02	.72	-.09	.20	.15	.46	.15	.82
FULL	-.07	.24	.90	-.15	-.10	.05	.24	.97
PART	.02	.22	-.03	.81	.08	.20	-.12	.76
HSEWFE	-.05	.27	.07	-.02	.90	.15	-.10	.92
STUD	.15	.90	-.01	.17	.13	-.23	.07	.94
PRESCH	-.25	.12	.14	.20	.25	.77	.03	.80
MALINC83	-.86	-.26	.35	.04	-.16	-.02	-.05	.96
FEMINC83	-.15	-.22	.38	.08	-.77	-.17	-.02	.85
PART83	-.15	.17	-.16	.94	-.16	-.05	.08	.99
UNEMP	.25	.51	-.23	-.13	.05	.67	-.12	.85
FULL83	-.55	-.19	.81	-.11	-.08	-.04	.10	1.02
COUNTRY	.66	.14	.01	.37	.41	-.06	.14	.78
COMMUTER	.02	.07	.23	-.03	-.05	.00	.95	.97

TABLE 24

Variables Associated with Principal Components
Fort Norman

COMPONENT 1

Male Income

a) Age of Respondent	(RESAGE)
b) Resident Years	(RESYR)
c) Male Head Income 1983	(MALINC83)
d) Last Residence Years	(LASTYR)
e) % Country Food in Diet	(COUNTRY)

COMPONENT 2

Family Structure

a) Number of Members in Household	(HSEMEM)
b) Number of Males	(MALE)
c) Number of Females	(FEMALE)
d) Number of Students	(STUD)

COMPONENT 3

Full Time Work

a) Members Employed Full Time	(FULL)
b) Full Time Income 1983	(FULL83)

COMPONENT 4

Part Time Work

a) Members Employed Part Time	(PART)
b) Part Time Income 1983	(PART83)

COMPONENT 5

Female Income

a) Number of Housewives	(HSEWFE)
b) Female Head Income 1983	(FEMINC83)

COMPONENT 6

Unemployed

a) Number of Preschoolers	(PRESCH)
b) Number of Members Unemployed	(UNEMP)

COMPONENT 7

Commuter

a) Commuters in Household	(COMMUTER)

TABLE 25

Explanation of Variance by Seven Principal Components for Wrigley

FACTOR	EIGENVALUE	PERCENTAGE OF VARIANCE	CUMULATIVE PERCENTAGE
1	4.26	26.7	26.7
2	2.71	16.9	43.6
3	2.42	15.1	58.7
4	1.74	10.9	69.6
5	1.36	8.5	78.1
6	1.07	6.7	84.8
7	.91	5.7	90.5

TABLE 26

Varimax Rotated Principal Components Matrix for Fort Norman

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	COMMUNALITY
RESAGE	.53	-.24	-.16	.16	.69	.05	.13	.89
RESYR	-.03	-.06	.20	.09	.90	.09	-.04	.86
HSEMEM	.95	-.02	.03	.17	.19	.13	.09	.99
MALE	.76	-.02	-.08	.45	.16	.36	-.13	.97
FEMALE	.73	-.01	.19	-.29	.13	-.27	.37	.88
FULL	.19	.77	.27	-.22	.11	-.30	.15	.87
PART	.09	-.24	-.25	.78	.07	-.44	.08	.95
HSEWFE	.47	-.02	.44	.14	-.24	-.45	-.41	.87
STUD	.88	-.06	-.33	.06	-.17	-.02	-.12	.93
PRESCH	-.06	-.07	.89	-.06	.07	-.11	.11	.84
MALINC83	-.20	.82	-.12	-.01	-.32	.02	-.03	.83
PART83	.16	-.07	.17	.95	.13	.06	.13	1.00
UNEMP	.15	-.25	-.02	-.09	.10	.89	.04	.89
FULL83	-.05	.99	.03	-.08	-.03	-.09	-.10	1.00
COUNTRY	.08	-.04	.36	.23	-.03	.05	.87	.95
COMMUTER	-.12	.16	.84	.05	.08	.08	.18	.79

TABLE 27

Variables Associated with Principal Components
Wrigley[1]

COMPONENT 1

Family Structure

a) Number of Members in Household	(HSEMEM)
b) Number of Males	(MALE)
c) Number of Females	(FEMALE)
d) Number of Students	(STUD)

COMPONENT 2

Male Income

a) Male Head Income 1983	(MALINC83)
b) Members Employed Full Time	(FULL)
c) Full Time Income 1983	(FULL83)

COMPONENT 3

Commuter

a) Number of Preschoolers	(PRESCH)
b) Commuters in Household	(COMMUTER)

COMPONENT 5

Part Time Work

a) Members Employed Part Time	(PART)
b) Part Time Income 1983	(PART83)

COMPONENT 5

Age

a) Age of Respondent	(RESAGE)
b) Resident Years	(RESYR)

COMPONENT 6

Unemployed

a) Number of Members Unemployed	(UNEMP)

COMPONENT 7

Country Food

a) % Country Food in Diet	(COUNTRY)

[1]Female Income 1983 (FEMINC83); Years Last Residence (LASTYR), excluded because they are near constants.

8. DIAND MONITORING REPORTS

Interim Report. R.M. Bone, September 1982.

Report 1-83. Norman Wells Project: 1983 Field Activities Report. Robert J. Mahnic and John W. Pomeroy, July 1983.

Report 2-83. Database and Survey Discussions Report. R.M. Bone, July 1983.

Report 3-83. Presentations at the Calgary Workshop: Monitoring the Socio-Economic Impacts of the Norman Wells Project and the Norman Wells Energy Project: A Problem of Monitoring. R.M. Bone, M.B. Green and R.J. Mahnic, August 1983.

Report 4-83. Norman Wells Project: Overview 1983. R.M. Bone, November 1983.

Report 1-84. The DIAND Socio-Economic Monitoring Program: Its Methodology and Data Verification. R.M. Bone, September 1984.

Report 2-84. Attitudes Towards the Norman Wells Project. Sheena Bates, September 1984.

Report 3-84. Analysis of Rankings of Socio-Economic Impacts of the Norman Wells Pipeline Project. M.B. Green and R.M. Bone, October 1984.

Report 4-84. Changes in the Size of the Native Labour Force from 1982 to 1983. Sheena Bates, November 1984.

Report 5-84. The Norman Wells Energy Report: Establishment of Socio-Economic Conditions. M.B. Green and R.M. Bone, March 1984.

Report 6-84. Assessment of Selected Statistical Data from the GNWT. Debra Brown, November 1984.

Report 7-84. Analysis of the Business Sectors of Norman Wells, Fort Norman, Wrigley and Fort Simpson, 1982 to 1983. P.T. Bates, November 1984.

Report 8-84. Impact of the Norman Wells Project on the Economic Base of Norman Wells, Fort Norman, Wrigley and Fort Simpson, 1982 to 1983. P.T. Bates, November 1984.

Report 9-84. DIAND Norman Wells Socio-Economic Monitoring Program: A Three-Year Review. Robert M. Bone, December 1984.

Copies of these reports can be obtained by contacting Norman Wells Project, Department of Indian Affairs and Northern Development, Les Terrasses de la Chaudiere, Ottawa, K1A 0H4.